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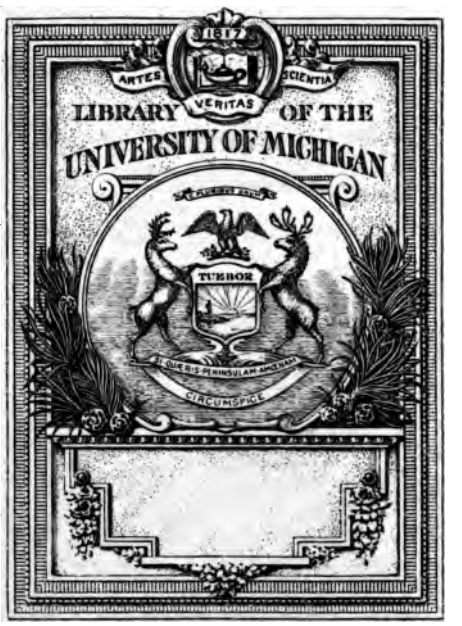
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
TUEBOR
CIRCUMSPICE

U. S. Congress. Joint committee on printing

MEMORANDA

RELATIVE TO

BINDING OF PUBLICATIONS FOR DISTRIBUTION TO STATE AND TERRITORIAL LIBRARIES AND DESIGNATED DEPOSITORIES

INCLUDING

1. LETTER OF INQUIRY ADDRESSED TO LIBRARIANS AND TABULATED STATEMENT OF REPLIES THERETO
2. MISCELLANEOUS EXPRESSIONS OF LIBRARIANS AND OTHERS
3. REPORTS BY UNITED STATES BUREAU OF STANDARDS ON CHEMICAL AND PHYSICAL TESTS APPLIED TO TWENTY-TWO SPECIALLY SELECTED SAMPLES OF BOOK CLOTHS SUBMITTED FOR EXAMINATION, AND TWENTY-TWO MISCELLANEOUS SAMPLES FROM MANUFACTURERS' CATALOGUES
4. MEMORANDA SUBMITTED BY THE LIBRARIAN OF CONGRESS
5. ACTION OF THE JOINT COMMITTEE ON PRINTING

WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

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LETTER OF INQUIRY ADDRESSED TO LIBRARIANS AND TABULATED STATEMENT OF REPLIES THERETO.

MEMORANDUM—BINDING.

Under an arbitrary provision contained in section 54 of the act of January 12, 1895, reading as follows: "These documents shall be bound in full sheep," neither the Public Printer nor the Joint Committee on Printing have had authority to direct the use of any other material. Private publishers and custodians of books generally have shown a decided preference for other materials, and the librarians of the various depositories, as well as the American Library Association, whose experts have investigated the durability of various binding materials, have entered numerous protests against the continued use of the sheep binding.

In order to avail itself of the results of these investigations the Commission recently addressed the following letter to more than 100 librarians, including those in charge of all the principal libraries of the country:

JOINT COMMITTEE ON PRINTING,
HOUSE OF REPRESENTATIVES,
Washington, February 5, 1907.

To the Librarian:

The Printing Investigation Commission is desirous of obtaining the views of the librarians of the important libraries of the country on the subject of the style of binding for Congressional documents and reports, which heretofore have been distributed in sheep bindings to the designated depository and State and Territorial libraries.

Please indicate your preference by a cross in the square opposite the entry on the inclosed card in order that the returns may be tabulated.

It is the desire of the Commission that in formulating your reply you take into account only durability, utility, and popular favor, disregarding entirely the element of cost.

Very respectfully,

C. B. LANDIS,
Chairman Subcommittee, Etc.

Of the following styles of binding, which do you prefer?
Please indicate your preference in the square opposite the entry, and in so doing only durability, general utility, and popular favor should be taken into account, disregarding entirely the element of cost.

1. Full sheep, such as is now used in the numbered Congressional documents and reports ☐
2. Half russia (cowhide), with marbled paper sides, such as is now used on the Congressional Record ☐
3. Cloth, similar in quality to that used on the recent publications of the Census Office and the special reports of the Librarian of Congress ☐
4. Buckram, similar in quality to that used on the Records of the Virginia Company of London ☐
5. Linen duck ☐
6. Canvas ☐

Name of library.....
City.....
State.....

The Commission was particular to ask that the element of cost be not considered in the expression of a preference, desiring to avoid an expression which might be influenced by considerations of economy. Responses to the number of 124 have been received and tabulated as follows:

	Full sheep.	Half russia (Congressional Record).	Cloth (special reports Library of Congress).	Buckram (Records of Virginia Company).	Linen.	Canvas.
	1	2	3	4	5	6
Albany, N. Y.:						
New York State Law Library				1	1	
Amherst, Mass.:						
Amherst College Library				1		
Annapolis, Md.:						
U. S. Naval Academy Library	1		1			
Ann Arbor, Mich.:						
General Library, University of Michigan				1		
Augusta, Me.:						
Maine State Library				1		
Austin, Tex.:						
University of Texas Library				1		
Baltimore, Md.:						
Enoch Pratt Free Library		1	1	1	1	1
Johns Hopkins University Library	1					
Peabody Institute Library			1	1		1
Berkeley, Cal.:						
University of California Library				1		
Bloomington, Ind.:						
Indiana University Library					1	
Boston, Mass.:						
State Library of Massachusetts				1		
Boston Athenaeum Library						1
Public Library				1		
Boulder, Colo.:						
Buckingham Library, University of Colorado	1					
Brooklyn, N. Y.:						
Brooklyn Public Library			1			
Pratt Institute Free Library					1	
Brunswick, Me.:						
Bowdoin College Library				1		
Buffalo, N. Y.:						
Grosvenor Public Library				1		
Public Library			1			
Burlington, Vt.:						
Fletcher Free Library			1			
University of Vermont Library						
Cambridge Mass.:						
Harvard University Library				1		
Chicago, Ill.:						
John Crerar Library			1			
Newberry Library			1			
Northwestern University Library				1		
Public Library				1		
University of Chicago Library				1		
Cincinnati, Ohio:						
Public Library			1			
Cleveland, Ohio:						
Public Library				1	1	1
Case Library						
Colorado Springs, Colo.:						
Coburn Library, Colorado College						
Columbia, Mo.:						
Missouri State University Library		1				
Columbus, Ohio:						
Ohio State Library				1		
Public Library				1		1
Concord, N. H.:						
New Hampshire State Library				1		
Crawfordsville, Ind.:						
Wabash College Library			1	1		
Dayton, Ohio:						
Public Library					1	1
Denver, Colo.:						
Public Library		1				

	Full sheep.	Half russia (Congressional Record).	Cloth (special reports Library of Congress).	Buckram (Records of Virginia Company).	Linen.	Canvas.
	1	2	3	4	5	6
Detroit, Mich.:						
Public Library				1		
Dover, N. H.:						
Public Library		1				
Dubuque, Iowa:						
Carnegie-Stout Free Public Library				1		
El Paso, Tex.:						
Public Library				1		
Fall River, Mass.:						
Public Library		1				
Fort Wayne, Ind.:						
Public Library			1			
Fort Worth, Tex.:						
Carnegie Library		1				
Grand Rapids, Mich.:						
Public Library			1			
Hanover, N. H.:						
Dartmouth College Library				1		
Hartford, Conn.:						
Connecticut State Library				1		
Trinity College Library				1		
Harrisburg, Pa.:						
Pennsylvania State Library			1			
Indianapolis, Ind.:						
Indiana State Library				1		
Iowa City, Iowa:						
State University of Iowa Library		1				
Ithaca, N. Y.:						
Cornell University Library				1		
Jamestown, N. Y.:						
James Prendergast Free Library		1		1		1
Jersey City, N. J.:						
Free Public Library				1		
Kansas City, Mo.:						
Public Library			1			1
Knoxville, Tenn.:						
University of Tennessee Library		1				
Lincoln, Nebr.:						
University of Nebraska Library		1				
Los Angeles, Cal.:						
Public Library				1		
Louisville, Ky.:						
Free Public Library				1		
Manchester, N. H.:						
City Library			1	1		1
Memphis, Tenn.:						
Cossitt Library				1		
Minneapolis, Minn.:						
University of Minnesota Library				1		
Public Library				1		
Morgantown, W. Va.:						
West Virginia University Library				1		
Nashville, Tenn.:						
Vanderbilt University Library						
Carnegie Library						
New Bedford, Mass.:						
Public Library				1	1	
New Haven, Conn.:						
Yale University Library				1		
New London, Conn.:						
Public Library						
New Orleans, La.:						
Howard Memorial Library				1		
New Orleans Public Library	1					
Tulane University Library	1					
Newark, N. J.:						
Newark Public Library			1	1		
New York, N. Y.:						
Astor Branch, New York Public Library				1		
Colnmbia University Library				1		1
College of City of New York Library			1	1	1	
Lenox Branch, New York Public Library				1		
Norfolk, Va.:						
Public Library						1
Northampton, Mass.:						
Forbes Library			1			

	Full sheep.	Half russia (Congressional Record).	Cloth (special reports Library of Congress).	Buckram (Records of Virginia Company).	Linen.	Canvas.
	1	2	3	4	5	6
Notre Dame, Ind.:						
Lemonnier Library, Notre Dame University				1		
Oberlin, Ohio:						
Oberlin College Library		1	1	1	1	1
Omaha, Nebr.:						
Public Library						
Orono, Me.:						
University of Maine Library				1		
Paterson, N. J.:						
Free Public Library				1		
Philadelphia, Pa.:						
Free Library of Philadelphia				1	1	
Wagner Free Institute of Science Library						
Franklin Institute Library			1			
Mercantile Library of Philadelphia						
University of Pennsylvania Library						1
Historical Society of Pennsylvania Library	1					
Library Company of Philadelphia						
Pittsburg, Pa.:						
Carnegie Library				1		
Portland, Me.:						
Public Library		1				
Portland, Oreg.:						
Library Association		1				
Princeton, N. J.:						
Princeton University Library						1
Providence, R. I.:						
Rhode Island State Library					1	
Brown University Library					1	
Public Library				1		
Richmond, Va.:						
Virginia State Library	1					
Rochester, N. Y.:						
Rochester University Library				1		
St. Joseph, Mo.:						
Free Public Library		1		1	1	
St. Louis, Mo.:						
Public Library					1	
Sacramento, Cal.:						
California State Library				1		
San Francisco, Cal.:						
Free Public Library				1		
Mechanics' Institute Library				1		
Savannah, Ga.:						
Georgia Historical Society Library		1				
Scranton, Pa.:						
Public Library				1		
Seattle, Wash.:						
University of Washington Library			1			
Public Library		1				
Stanford University, Cal.:						
Leland Stanford, Jr., University Library						1
Syracuse, N. Y.:						
Syracuse University Library				1		
Terre Haute, Ind.:						
Indiana State Normal School Library						1
Toledo, Ohio:						
Public Library			1	1	1	1
Trenton, N. J.:						
Free Public Library			1			
New Jersey State Library	1					
Utica, N. Y.:						
Public Library			1			
Valparaiso, Ind.:						
Northern Indiana Normal School Library	1					
Washington, D. C.:						
Department of State Library	1					
Treasury Department Library		1				
War Department Library		1				
Navy Department Library		1				
Department of Justice Library				1	1	

	Full sheep.	Half russia (Congressional Record).	Cloth (special reports Library of Congress).	Buckram (Records of Virginia Company).	Linen.	Canvas.
	1	2	3	4	5	6
Washington, D. C.—Continued.						
Post-Office Department Library				1		
Department of Interior Library			1			
Department of Agriculture Library				1		
Library of Congress				1	1	
H. H. B. Meyer, Chief, Order Department, Library of Congress				1	1	
Public Library of the District of Columbia				1	1	
Waterbury, Conn.:						
Silas Bronson Library			1		1	1
Wilmington, Del.:						
Wilmington Institute Free Library				1		
A. L. Bailey, Chairman of Committee on Bookbinding, A. L. A.				1		
Worcester, Mass.:						
Public Library				1		
American Antiquarian Society Library	1					
Worcester County Law Library						1

Where more than one preference was expressed it has been made to appear in the above table. Concretely stated, the expression of preference is as follows:

Full sheep	11
Half russia	18
Cloth	25
Buckram	70
Linen duck	20
Canvas	19

During the Fifty-eighth Congress there were bound for the depository libraries 162,000 volumes, the cost of which would be as follows if bound in the respective styles enumerated below:

Sheep, at 75 cents per volume	$121,500
Half cowhide, at 75 cents per volume	121,500
Linen duck, at 30 cents per volume	48,600
Canvas, at 28 cents per volume	45,360
Buckram, at 24 cents per volume	38,880
Cloth, at 22 cents per volume	35,640

COMMENTS OF LIBRARIANS.

A number of the expressions in favor of the continued use of sheep binding were qualified by the statement that they were prompted solely by the consideration of uniformity. From a large number of expressions more in detail a few are here collated.

Indiana State Library:

We look upon the shelves in the stack room and observe the lesson that time alone can teach. Upon our shelves this one lesson is clear: That no leather of recent manufacture, except the most expensive morocco, is fit for bookbinding. It is also apparent that even the poorest quality of binder's cloth will far outlast any but the most expensive leather. * * * I trust the time may soon come when all the States and the National Government may entirely quit the use of leather in bookbinding. * * * Such cloth as I have mentioned above, 38 inches wide, costs but 20 cents per yard, while the same surface area of leather of the most worthless quality costs six times as much.

The John Crerar Library, Chicago:

The John Crerar Library has purchased in the last ten years nearly 200,000 volumes, of which a large proportion—say one-half—it has had bound in Chicago or elsewhere. According to our experience the best binding is a genuine morocco, which is not included in your list. Of those given, so far as the wearing qualities are concerned, cloth, buckram, duck, and canvas would be about equal, but our experience shows that duck is apt to collect dirt and canvas to be too slippery. * * * We earnestly hope that the Government will not depend upon labels. For the above reasons we therefore register our preference for cloth similar to that of the special reports of the Library of Congress.

New York State Library:

I have consulted all the members of our staff who are in a position to have an intelligent opinion on the subject, including the law librarian and Mr. J. I. Wyer, vice-director of the New York State Library School, which is also a part of the State Library. * * * He has therefore given a good deal of attention to the subject and agrees with all of us here that a good heavy linen cloth would be the best material to use in binding Congressional documents and reports.

Providence (R. I.) Public Library:

Of all the materials included in your list, No. 1 "sheep" is by far the most objectionable style of binding. There are volumes published by the United States Government bound in this material standing on our shelves, which, little by little, are becoming disintegrated. The fine powder which they constantly deposit on the shelves has to be wiped away from time to time.

Dr. George F. Bowerman, Public Library, District of Columbia (formerly chairman of the committee on binding of the American Library Association):

I believe that sheep is useless. * * * Buckram of the quality mentioned would be best for the lighter-weight documents; but linen duck, I believe, should be used for the large, heavy documents. * * * I am very glad that your committee is looking into this matter. Sheep binding has been, or is being, generally discarded by publishers who are abreast with the best methods. It would be a pity to have the United States Government continue to use an antiquated, undurable method, especially when it is a very expensive one.

Library of the University of Vermont:

I do not now think of anything published by the Government for which I should recommend sheep.

Post-Office Department Library:

From among cloth, linen duck, canvas, and buckram it would be difficult to choose, but my preference is for the buckram. * * * One noticeable effect of time has been the crumbling away of the sheep binding in such a marked manner as to leave very much of the binding on the hands and clothing when handling the books so bound.

A. L. Bailey, chairman American Library Association Committee on Binding:

Buckram is the least objectionable, but before the Committee on Printing makes a final decision I think it ought to consider the specifications drawn by the American Library Association Committee on Binding.

Scranton (Pa.) Public Library:

I should by all means specify the polished buckrams, * * * but no leathers, at any odds, unless it might be the Turkey morocco.

State Library of New Jersey:

Our preference for the full sheep is because of a desire to keep our set uniform in appearance; otherwise the buckram binding would be first choice.

Dayton (Ohio) Public Library:

Our sheep bindings are rotting; would much appreciate a change.

Wabash College Library, Crawfordsville, Ind.:

If buckram and cloth could be made uniform in appearance, use both; prefer them to sheep or russia.

Hon. Elihu Root, Secretary of State:

I would much prefer cloth to sheep at the same cost, and it is certainly much less expensive.

Here is the anomaly of the Government paying 75 cents per volume for the binding of books for libraries in the face of their expressed preference for a binding costing half as much.

REPORT OF THE UNITED STATES BUREAU OF STANDARDS ON CHEMICAL AND PHYSICAL TESTS APPLIED TO TWENTY-TWO SPECIALLY SELECTED SAMPLES OF BOOK CLOTHS SUBMITTED BY THE JOINT PRINTING INVESTIGATION COMMISSION, AND TWENTY-TWO MISCELLANEOUS SAMPLES FROM MANUFACTURERS' CATALOGUES.

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[Test 3552.]

REPORT OF THE CHEMICAL DIVISION, BUREAU OF STANDARDS, ON THE EXAMINATION OF CERTAIN SAMPLES OF BOOK CLOTHS AND BUCKRAMS SUBMITTED BY THE PRINTING INVESTIGATION COMMISSION OF CONGRESS.

The objects of the following investigation were:

First. To determine the extent to which the samples of book cloths submitted are subject to the attack of insects, and to ascertain, if possible, the conditions favoring or discouraging such attacks and a means of preventing them.

Second. To determine the relative liability to change of color when exposed to light.

The material experimented upon consisted of two groups:

First. A series of 23 samples of specially selected cloths submitted by the Commission.

Second. A book of 39 samples submitted by the Public Printer. These were divided in the sample book as follows: (*a*) Book cloths seldom attacked by insects; (*b*) book cloths frequently attacked; (*c*) buckrams, all of which are said to be attacked; (*d*) miscellaneous samples for which data are lacking.

ATTACK BY INSECTS.

Inquiry among several large manufacturers and users of book cloths failed to elicit any information of value. It was generally recognized that the insects feed upon the starch, gum, or flour paste with which the cloths are coated, and while it was claimed that some cloths were relatively immune, no reason was given for this. The Holliston Mills submitted two samples of cloth which had been used extensively in the Philippines, one of which had given rise to numerous complaints, while no unfavorable reports had been received regarding the other. Our experiments showed that the one supposed to be immune was readily attacked, while the one reported as frequently attacked was left untouched. This is given simply to show with what reservation such reports must be accepted, coming, as they do, from localities where the conditions may differ totally, and depending on the personality of the observer.

We are indebted to the Bureau of Entomology, Department of Agriculture, for the information that the principal insects in this country which are destructive to book covers are the small German cockroach (*Ectobia germanica*), also known as croton bug or water bug, and the silver fish or slickers (*Lepisma saccharina*), as well as, possibly,

some smaller varieties of insects. It was suggested that the poisoning of the paste with arsenic might afford an effective remedy.

The investigations in this laboratory were limited to the behavior of croton bugs, these being the only insects above mentioned which could readily be secured in sufficient quantity.

The method of experimenting consisted in placing in a ventilated glass vessel nearly uniform strips of all the samples at the same time, together with a large number of croton bugs. The strips were secured with wax, face side up, to a glass plate, and the insects were liberally provided with water, but were given no food other than the cloth strips. After many days' exposure, during which some of the cloths had been completely stripped, while others were unattacked, the samples were removed and replaced by a duplicate set, and finally by a third set. The results with the first set could not be regarded as proving anything, as the stripping of a particular sample would indicate nothing more than that this piece, having been tasted and found edible, would be returned to again and again. In short, it might be attributed to force of habit and the imitative character of the creature. If, however, the results were the same with the second and third sets of samples, this would afford a strong presumption that certain cloths, for one reason or another, appealed particularly to the tastes and appetites of the insects.

The general result was that the same cloths were attacked in each case, and the same were untouched. The result would have been more convincing had it been possible to repeat the experiment several times more with different sets of croton bugs. Nevertheless the great uniformity in the three sets affords a strong presumption that there is a marked difference in the cloths themselves, which can not be regarded as accidental. The experiments do not prove, however, that if forced by hunger the bugs would not attack even the more resisting cloths, and it is quite possible that a collection of books bound with these only might still become a prey to the insects.

The accompanying cards, numbered to correspond with the cloths, show the specimens after exposure to the insects for the times indicated. A separate card carries miscellaneous samples selected from the sample book submitted by the Public Printer.

Table I shows the general results of the experiments on the specially selected samples, arranged in the order of resistance to insects, those least affected standing first. The table also contains some analytical data.

TABLE I.—*Action of croton bugs on selected samples.*

Number of cloth.	Action of croton bugs.	Coating in 1 square dm. in grams.	Per cent ash in coating.	Per cent zinc oxide in coating.	Remarks.
777	None	0.54	6.9	1.79	Chrome yellow.
999	do	.59	6.3	2.83	Do.
22	do	.39	34.7	23.66	Do.
55	do	.62	50.9	44.84	Do.
55 (1)	do	.72	45.7	.....	Do.
666	Practically none	.46	8.7	None.	
	Average	.55	25.5	.....	
888	Slight	.57	8.1	.....	
5	do	.85	28.1	.....	Do.
44	do	.57	22.1	8.88	Do.
6	do	.87	40.9	.....	Do.
4	do	.88	21.0	.....	Do.
3	do	1.01	14.0	.....	Do.
	Average	.79	22.4	.....	
66	Medium	.73	12.7	.....	Do.
2	do	.61	17.9	.....	Do.
33	do	.36	38.9	.....	
555	do	.43	2.1	.....	
	Average	.53	17.9	.....	
333	Strong	.44	3.2	.69	
	Average	.44	3.2	.....	
77	Very strong	.63	22.8	.....	
11	do	.72	15.0	.....	
	Average	.67	18.9	.....	
1	Nearly stripped	.73	6.9	5.75	
444	do	.53	7.9	.89	Do.
222	do	.70	8.7	.....	
111	do	1.51	32.6	2.32	Do.
	Average	.82	14.0	.....	

Table II shows the result of a single experiment with alternate samples taken from the book submitted by the Public Printer. While this can not be regarded as conclusive as if more tests had been made, it has still some value, as the time of exposure was forty-two days. The samples are arranged in the table according to the classification of the Public Printer, viz, 1. "Seldom attacked;" 2. "Frequently attacked;" 3. "Buckrams, all of which are attacked;" 4. "Samples regarding which no information is at hand." It may be mentioned that these are comparable only among themselves, not with those of Table I, the time of exposure having been much longer.

TABLE II.—*Action of croton bugs on samples from Public Printer.*

No. on sample card.	Designation.	Classification of the Public Printer.	Observed action of croton bugs.
1	Green cloth, T pattern	Seldom attacked	Medium.
2	Red cloth, C pattern	do	Completely stripped.
3	Light brown, D pattern	do	None.
4	Blue cloth, J pattern	do	Very strong.
5	Red cloth, J pattern	do	None.
6	Green cloth, S pattern	do	Do.
7	Blue cloth, C pattern	Frequently attacked	Completely stripped.
8	Red cloth, T pattern	do	Medium.
9	Buckram, 45–C	Attacked	Completely stripped.
10	Buckram, R–2	do	Slight.
11	Buckram, 28–B	do	Completely stripped.
12	Buckram, yellow A.C. special	do	Medium.
13	Buckram, 66–S	do	Very strong.
14	Buckram, 47–B	do	Completely stripped.
15	Buckram, purple	No information	Medium.
16	Buckram, brown	do	Trace.
17	Buckram, green	do	Slight.
18	Buckram, maroon No. 2	do	Do.
19	Buckram, light brown	do	None.
20	Buckram, fawn	do	Completely stripped.
21	Law buckram, light	do	None.
22	Holliston Library duck, slate.	do	Do.

CAUSES FAVORING IMMUNITY.

The causes rendering certain of the cloths unattractive to the bugs have been sought for, but with little success. It is easy to state certain conditions which might lead to this result, but these would be based largely on preconceived opinions as to what the bugs should or should not find attractive. We are dealing with a very complicated question and one which involves not only the physical and chemical properties of the cloths, but the anatomy, physiology, and psychology of an animal of which we know very little. If it is impossible to account for the tastes of human beings, so much the more must it be impossible in the case of insects. That substances which are poisonous or disagreeable to men are sometimes harmless or attractive to other organisms, and vice versa, is well enough known. Differences of hardness, thickness of the layer of nutritious material, the presence or absence of inert matter or of certain chemicals, pigments, or dye stuffs may influence the insects in a hundred ways of which we can form no conception. This is well illustrated by the poison tests to be referred to later. We have therefore endeavored to find some positive and unmistakably characteristic differences between the cloths attacked by bugs and those which were immune, but unfortunately without result.

The weight of coating per square decimeter of surface which may be regarded as roughly expressing the thickness of the coating is given in Table I. No definite relation appears to exist between this and the liability to attack, and the averages of the different groups do not differ enough to indicate any significance in this factor.

The percentage of ash in the coating may be taken to express roughly the amount of inert or indigestible matter as distinguished from nutritive material. The averages of the first two groups shown in Table I are decidedly higher than those of the last two. The average of the first group is nearly twice as great as that of the last, seeming to indicate a preference for richer diet; but on examining individual cases striking exceptions are noted. Thus, a cloth with 6.3 per cent ash in the coating is left untouched, while one with 32.6 per cent is stripped.

Chrome yellow is used as a pigment in 15 out of the 22 samples. This contains both lead and chromic acid, both of which are poisonous, and while no quantitative determinations were made it seems to be about evenly distributed throughout the series. There was no evidence that this pigment was fatal to or avoided by the insects.

Zinc salts are contained in a number of the samples and were determined in 10 cases, the results being given in Table I. The figures expressing percentage of zinc oxide in the coating do not indicate that moderate amounts have any deterrent effects.

It appears that none of the factors considered gives decisive evidence of exerting any marked influence on the susceptibility to attack by insects. Any decisive results, if they can be reached at all, could only be obtained with the use of a much greater variety of material and much more time than we have had at our disposal. The samples vary in many different ways, while the first requisite for satisfactorily showing the influence of different factors would be several series of samples, in each of which one factor only should vary. We are therefore compelled to be satisfied with the results as shown by each of these samples, leaving broader conclusions to be decided by future investigations.

We call particular attention to the fact that insects do not appreciate the difference between covers designated as "buckram" and others. The bugs do not eat the original fabric, which consists of cellulose, but subsist on the nutritious materials of the coating. The nature of the basis, the fabric, is naturally a matter of indifference to them. This is well illustrated without further comment by reference to the cards and tables, including the samples submitted by the Public Printer. There is absolutely no evidence to show that buckrams are more or less liable as a class to attack by croton bugs than other covers.

POISON TESTS.

Some experiments were made as to the possibility of immunizing cloth by making it unattractive. The addition of arsenic to the coating is objectionable for two reasons. Arsenic is universally regarded as an objectionable constituent in wall papers or wearing apparel, and, in fact, is in some countries strictly prohibited by law. Further, arsenic is odorless and practically tasteless, and might not be detected by the bug. It is well known that animals will often eat material otherwise attractive when loaded with arsenic. The object of any protective material in book cloths would be not to kill the insect after the cloth is eaten and the damage done, but to possess so repulsive a nature that the creature will not try a second bite.

If insects are so strongly repelled by bitter substances as human beings, strychnine would seem to be an almost ideal material to use, for it is by far the most intensely bitter of any easily available substance, and while very poisonous its bitter qualities are such that it might be used in very small amounts. Quinine, while much less bitter, has the advantage of being cheaper and harmless.

We have, therefore, made experiments with these two alkaloids in the following manner:

Of three identical strips of cloth, No. 333, which is strongly attacked, one was soaked for five minutes in pure water, a second in a solution of 167 mg. quinine in 1,000 cc. water, and a third in a solution of 167 mg. strychnine in 1,000 cc. water, and then dried. They were then

placed in a cage containing croton bugs for ten days. The strips containing the alkaloids were attacked quite as much as that treated with pure water.

Three strips of buckram, "37-S," were similarly treated and showed no difference in behavior.

Strips of "buckram, 37–S," soaked in solutions of 833 mg. per liter of quinine and of strychnine were as readily attacked as that treated with pure water, and were finally almost stripped. At the end of ten days the bugs did not appear to have suffered from the poison, but on the contrary were markedly more active than those not so fed. The strength of the solution of strychnine used in the last case was such that 25 drops would about equal the ordinary medicinal dose. The experiments were not carried further, as the use of a stronger strychnine would be not only prohibitive from its cost, but dangerous to workmen.

The strips are exhibited on one of the cards. From this it may be concluded that strychnine up to the limits at which it could practically be used does not protect book cloths from croton bugs.

ACTION OF LIGHT ON THE COLORS.

The permanency of the coloring material of book cloths when exposed to light is a matter of considerable importance, and a series of experiments was made, as follows:

Strips of each of the cloths were fastened to a board, one-half of each strip being covered, the other exposed to direct sunlight for 35, 81, and 167 hours. The results are thus strictly comparable and are exhibited in Table III and on the accompanying cards. The colored materials used may be grouped into two classes, mineral pigments and dyes. The mineral pigments consist chiefly of chrome yellow and oxide of iron, which in varying proportions give the yellows and browns, and ultramarine blue, which in conjunction with chrome yellow gives green. The dyes consist of various coal-tar or "aniline" colors, which are sometimes used as the chief coloring matter, but more often simply to modify the tint of the mineral pigment. In the present case no attempt was made to identify the exact dye used, the results of the test being otherwise sufficiently decisive.

TABLE III.—*Arranged with respect to action of light.*

No.	Action of light.	Action of croton bugs.
777	None	None.
999	do	Do.
888	do	Slight.
66	do	Medium.
333	do	Strong.
1	do	Nearly stripped.
444	do	Do.
666	Doubtful	Practically none.
222	do	Nearly stripped.
2	Slight (lighter)	Medium.
22	Medium (darker)	None.
5	do	Slight.
4	Decided (darker)	Do.
6	do	Do.
44	Decided (lighter)	Do.
55	Strong (lighter)	None.
55 (1)	do	Do.
3	Strong (darker)	Slight.
111	do	Nearly stripped.
88	Very strong (lighter)	Medium.
555	*do*	Do.
11	*do*	Very strong.
77	*do*	Do.

It may be laid down as a general rule that book cloths, being liable to exposure to sunlight in windows or on tables or shelves for an indefinite period, should be colored only with the fastest colors obtainable. In general, the mineral pigments are fast, while the organic dyes are liable to fade, some very rapidly, but all in the course of time, and if used to tone the faster pigments will lead to a discoloration which more than outweighs any slight advantage to be gained from their use. In our opinion, all organic, coal tar, or aniline dyes should be absolutely and unqualifiedly excluded from all book cloths intended for official publications, even as toners. While they are largely used at present because of their cheapness, the ease with which they can be applied, and their great variety and beauty, these are not sufficient to compensate for the disadvantages resulting from unequal or uneven fading. Mineral pigments of sufficient variety have stood the test of centuries, and no artificial dye has been used long enough to guarantee its fastness for the time during which a book may last. The only possible advantage in using the artificial dyes would be in dyeing the fiber through and through, so as to disguise the results of wear. This, however, is not ordinarily done, the color being applied in the coating paste to the undyed fabric, and even then such colors are used as are not and can not be taken up directly by the fiber. If it is desired to use such dyed fabrics as a base, no color should be permitted which has not stood the severest tests.

In the samples the following points should be noted: In most the change has practically reached its limit within thirty-five hours' exposure owing to the rapid destruction of the relatively unstable toning color. Only in the heavily dyed Nos. 77 and 555, and to a less degree in 11, is the change progressive. In a few cases the light has had a darkening effect, the cause of which is not clear, but which may perhaps be attributed to the destruction of a lighter coloring material.

BASIS FOR SELECTION.

In order to arrive at a basis for selection, as far as the above considered qualities are concerned, a compromise is necessary, as there is no parallelism between resistance to light and resistance to insects. These qualities are not susceptible of numerical expression, and no compounding of the results is possible, as is the case with the physical data.

In Table IV the samples are grouped into four classes, with respect to light and insects, as follows:

Class 1. Perfect or not more than slightly defective in either respect.
Class 2. Not poorer than medium in either respect.
Class 3. Poorer than medium in one respect.
Class 4. Poorer than medium in both respects.

TABLE IV.—*Compromise rating on basis of chemical data.*

No.	Action of light.	Action of croton bugs.
777	None	None.
999	.....do	Do.
666	Doubtful	Practically none.
888	None	Slight.
66	.....do	Medium.
2	Slight (lighter)	Do.
22	Medium (darker)	None.
5	.....do	Slight.
4	Decided (darker)	Do.
6	.....do	Do.
44	Decided (lighter)	Do.
55	Strong (lighter)	None.
55 (1)	.....do	Do.
3	Strong (darker)	Slight.
33	Very strong (lighter)	Medium.
555	.....do	Do.
333	None	Strong.
1	.....do	Nearly stripped.
444	.....do	Do.
222	Doubtful	Do.
111	Strong (darker)	Do.
11	Very strong (lighter)	Very strong.
77	.....do	Do.

The final classification must involve a compromise between the physical and chemical data. The former bear on the wearing quality of the cloth, while the latter are of importance mainly from the æsthetic standpoint, since a change of color does not affect the strength of the book and the same is practically true of the attacks of insects as far as these are limited, as they usually are, to the paste coating, which does not add very markedly to the strength. The physical data being likewise grouped into four classes, the cloths are arranged in Table V in the following groups:

(*a*) First physical and first chemical class.
(*b*) First class in one and second in the other.
(*c*) Second in both.
(*d*) First in one and third in the other.
(*e*) Second in one and third in the other.
(*f*) Third in both.
(*g*) Second and fourth, third and fourth.
(*h*) Fourth in both.

The change of color is usually due to the presence of very small amounts of organic dye which might be omitted without essentially modifying the other qualities. If it is found practicable to have the manufacturer introduce such modifications as will make the cloth fast toward light without changing the composition of the coating in any other respect, then certain cloths which have a high physical rating and which resist insects would receive a higher rating than in Table V. Such an arrangement is shown in Table VI. In suggesting such modifications attention is called to the fact that the darkening of some of the samples by light can not be attributed with certainty to the presence of organic dyes.

TABLE V.—*Final rating on basis of physical and chemical data.*

Order of choice.	No.	Physical class.	Chemical class.	Physical rating.	Action of light.	Action of croton bugs.
				Per cent.		
1	777	First	First	65	None	None.
2	999	do	do	63	do	Do.
3	2	do	Second	60	Slight (lighter)	Medium.
4	666	Second	First	53	Doubtful	Practically none.
5	888	do	do	52	None	Slight.
6	22	do	Second	53	Medium (darker)	None.
7	555	First	Third	64	Very strong (lighter)	Medium.
8	44	do	do	60	Decided (lighter)	Slight.
9	444	do	do	65	None	Nearly stripped.
10	55,55(1)	Second	do	56	Strong (lighter)	None.
11	4	do	do	53	Decided (darker)	Slight.
12	333	do	do	52	None	Strong.
13	66	Third	Second	42	do	Medium.
14	1	do	Third	49	Strong (darker)	Slight.
15	6	do	do	46	Decided (darker)	Do.
16	222	do	do	45	Doubtful	Nearly stripped.
17	11	Second	Fourth	54	Very strong (lighter)	Very strong.
18	5	Fourth	Second	33	Medium	Slight.
19	3	do	Third	37	Strong (darker)	Do.
20	33	do	do	27	Very strong (lighter)	Medium.
21	111	do	Fourth	27	Strong (darker)	Nearly stripped.
22	77	do	do	27	Very strong (lighter)	Very strong.

TABLE VI.—*Final rating if colors can be modified by omitting organic dyes.*

First	777	Twelfth	333
Second	999	Thirteenth	11
Third	2	Fourteenth	66
Fourth	666	Fifteenth	222
Fifth	44	Sixteenth	1
Sixth	55,55 (1)	Seventeenth	6
Seventh	22	Eighteenth	3
Eighth	555	Nineteenth	5
Ninth	444	Twentieth	33
Tenth	4	Twenty-first	77
Eleventh	888	Twenty-second	111

OTHER CHEMICAL CAUSES OF DETERIORATION.

It may not be out of place to call attention to certain other influences of a chemical nature which may possibly have a bearing on the durability of book cloths and which might be worthy of investigation.

The London Society of Arts carried out an extensive investigation on the causes contributing to the decay of leather bookbindings and arrived at many valuable conclusions. In book cloths we have a material which differs totally from leather in its chemical nature, but the question of its resistance to light, moisture, changes of temperature, the various normal and abnormal constituents of the atmosphere, micro-organisms, internal chemical changes, is not less important. As an illustration it may be mentioned that the chrome yellow used as a pigment in most of the cloths examined consists essentially of lead chromate. Lead compounds are subject to darkening with time through the action of traces of sulphureted hydrogen which are likely to be present in the atmosphere. The chromic acid constituent is a powerful oxidizer and the pigment is embedded in a paste which is easily oxidized. The possible deteriorating action of the pigment on the coating and of the coating on the pigment should, therefore, not be disregarded. Ultramarine blue, which is largely used, is sensitive to the action of acids and might in time be affected by the acid

gases contained in the atmosphere of all cities where coal is burned. Moreover, the combination of ultramarine and chrome yellow to give green, as it occurs in cloth No. 2, is not ideal, as ultramarine, being a sulphide, is likely to react with the chrome yellow. The flour paste of the coating is an excellent culture medium for micro-organisms and molds if exposed to moisture and not protected by suitable antiseptics. The presence of zinc and other salts in the paste has an important bearing on the hygroscopic qualities of the cloth. The action of the products of combustion of coal and illuminating gas, especially sulphur dioxide and sulphuric acid, is one regarding which little is known, but which is sure to be injurious.

An agent which will render the cloth certainly immune to the attacks of insects of all kinds is not yet known, or at least generally used.

These and many other questions must be investigated before a cloth which is ideal from the chemist's standpoint can be made.

SUMMARY.

1. There is a very marked difference in the samples with respect to attack by croton bugs, some being unattacked, others completely stripped under the same conditions.
2. Definite reasons for these differences have not been made out.
3. Strychnine in considerable amount does not make the cloths distasteful to croton bugs.
4. Buckrams, as a class, are not distinguished by immunity from or liability to attack by croton bugs.
5. There is a marked difference in the action of light on the samples.
6. Mineral colors only should be used, and organic dyes should be absolutely excluded, even as toners.
7. Compromise rating on the basis of chemical and physical tests.
8. Suggestions as to some further chemical causes of deterioration.
9. Exhibits showing action of bugs and of light are submitted.

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REPORT ON PHYSICAL TESTS ON TWENTY-TWO SAMPLES OF BOOK CLOTH SUBMITTED BY THE JOINT PRINTING INVESTIGATION COMMISSION.

DESCRIPTION.

The samples of book cloth submitted by the Joint Printing Investigation Commission were tested to determine the following physical properties, viz, weight, thickness, number of threads per 2 cm. absorption of moisture, expansion and contraction with changes in moisture, friction when pressed together, durability with respect to folding, durability with respect to rubbing, tensile strength, and stretch.

In tests involving variations in the values in different portions of the fabric, three specimens of each sample were tested and the values given in the tables are the averages. Values involving units are expressed in the metric system in which they were obtained, and the English equivalents are given in ( ) parentheses beneath each value.

PHYSICAL CHARACTERISTICS.

In order to facilitate the identification and duplication in the future of the various samples the characteristics collected in Table 1 were determined.

The weights given in this table are "bone dry," i. e., the weight of the fabric after the moisture had been evaporated from it by hanging in an air bath at a temperature of 110° C. for several hours.

TABLE No. 1.—*Physical characteristics.*

Sample marked—	Thread per 2 cm. (0.78 in.). Warp.	Weft.	Thickness in centimeters (inches).	Weight (bone dry) kilogram per M (pounds per yard).
3	24	23	0.0265 (0.0106)	0.21 (0.43)
4	25	23	0.0225 (0.0090)	0.22 (0.44)
111	27	24	0.0332 (0.0133)	0.30 (0.60)
222	28	24	0.0347 (0.0139)	0.22 (0.45)
77	32	24	0.0237 (0.0095)	0.22 (0.45)
55	32	24	0.0227 (0.0091)	0.22 (0.44)
44	33	22	0.0220 (0.0088)	0.20 (0.40)
333	38	32	0.0237 (0.0095)	0.18 (0.36)
22	41	26	0.0307 (0.0123)	0.29 (0.58)
11	42	46	0.0360 (0.0144)	0.39 (0.78)
33	42	46	0.0302 (0.0121)	0.29 (0.59)
2	51	35	0.0172 (0.0069)	0.16 (0.33)
444	54	40	0.0202 (0.0081)	0.18 (0.37)
1	55	34	0.0180 (0.0072)	0.16 (0.33)
888	57	27	0.0222 (0.0089)	0.20 (0.41)
999	59	28	0.0222 (0.0089)	0.25 (0.50)
66	68	18	0.0235 (0.0094)	0.23 (0.46)
5	72	19	0.0305 (0.0122)	0.30 (0.60)
6	72	19	0.0290 (0.0116)	0.31 (0.63)
777	74	23	0.0290 (0.0116)	0.25 (0.51)
666	76	23	0.0265 (0.0106)	0.26 (0.52)
555	91	43	0.0272 (0.0109)	0.22 (0.44)

ABSORPTION OF MOISTURE.

The samples were studied in three conditions—first, in the normal condition with the relative humidity of atmosphere at 65 per cent; second, after hanging in an air bath for two hours at a temperature of 25° C. and an atmosphere saturated with moisture; third, after hanging in an air bath for two hours at a temperature of 110° C. and air practically dry. The results are shown in Table 2.

The percentages are computed on the basis of bone-dry weights and dimensions. The expansion shows the tendencies the cloth would have to distort the binding with variation in moisture in the surrounding atmosphere. The absorption, i. e., "the percentage increase in weight," is a guide to capacity of the cloth for taking moisture from the paste and to the corresponding change in dimensions upon drying. Values preceded by the minus (—) sign were decreases.

TABLE No. 2.—*Showing absorption of moisture and the expansion at different relative humidities of atmosphere computed on a basis of "bone dry" in oven at 110° C.*

Sample marked—	Percentage increase in weight (relative air humidity).		Percentage increase in dimensions (relative air humidity).[a]					
			65 per cent.			100 per cent.		
	65 per cent.	100 per cent.	Warp.	Weft.	Average.	Warp.	Weft.	Average.
666	4.2	9.0	0.27	0.60	0.43	2.60	1.41	2.00
6	4.3	9.4	.17	.98	.57	− .13	1.48	.67
66	4.7	11.8	.07	1.63	.85	.10	1.39	.74
2	4.8	8.1	.07	1.22	.64	− .17	1.65	.74
5	5.4	10.2	.13	.81	.47	2.60	1.38	1.99
11	6.0	10.4	.43	.91	.67	.40	1.61	1.00
888	6.1	11.4	.17	.87	.52	2.60	1.48	2.04
4	6.1	14.1	.33	1.45	.89	.30	2.74	1.52
777	6.3	10.9	.33	.33	.33	.03	1.07	.55
333	6.4	12.9	.20	.77	.48	2.70	3.50	3.10
22	7.1	9.6	.33	.98	.65	.30	1.14	.72
111	7.1	10.1	.47	1.08	.77	.33	1.92	1.12
77	7.1	10.3	.27	1.73	1.00	.27	2.58	1.42
55	7.4	9.5	.30	1.18	.74	− .33	1.65	.66
33	7.6	11.0	.99	.40	.69	.23	1.27	.75
999	7.6	10.2	.30	.33	.31	.03	1.24	.63
44	7.7	10.9	.17	.91	.54	.03	1.28	.65
222	8.0	10.5	.40	1.59	.99	.33	2.23	1.28
1	8.2	15.9	.23	1.25	.74	.00	2.67	1.33
444	8.9	13.6	.54	.91	.72	− .40	1.25	.42
555	11.3	18.6	.10	.64	.37	.30	1.14	.72
3	12.9	20.8	.13	1.18	.65	.03	1.99	1.01

[a] The minus (−) indicates a decrease.

FRICTION.

The friction tests were made to determine relatively the amount of force necessary to slide two specimens of the same sample upon each other. This represents the condition of the book shelves when a volume of a set is to be drawn out.

The specimens tested were 20.2 cm. ($9\frac{5}{8}$ inches) by 25.2 cm. ($7\frac{5}{8}$ inches), and they were laid upon each other with the warp crossed. Two sets of determinations were made at different pressures. The total normal pressure over the entire area was in each case 6.8 kg. (15 lbs.) and 10.5 kg. (23 lbs.), and the value given for the friction is the amount of force just necessary to start the two specimens sliding on each other. It was thought possible that the amount of moisture contained in the fabric might influence the values. In consequence, a set of observations was made on each sample after it had been hanging for two hours in a saturated atmosphere and after it had been made bone dry by hanging in an air bath maintained at a temperature of 110° C. for several hours. The results are shown in Table 3. In 11 samples the friction was greater for "bone dry" and "saturated" than at the normal air humidity. In 9 cases it was less at "bone dry" and greater at "saturated," and in 2 cases it was less in both extreme conditions.

TABLE NO. 3.—*Friction tests.*

Sample marked—	Friction in kilograms and equivalent (pounds).					Friction increase with change of humidity from normal.[a]	
	Normal, at air humidity 65 per cent pressures.			Bone-dry air, 6.8 and 10.5 kgms. (average).	Saturated air, 6.8 and 10.5 kgms. (average).		
	68 kgms. (15 lbs.).	10.5 kgms. (23 lbs.).	Average.			Dry.	Saturated.
						Per ct.	*Per ct.*
1	0.4	2.0	1.2	2.8	2.9	135	142
	(0.9)	(4.3)	(2.6)	(6.1)	(6.3)		
4	1.3	1.8	1.5	3.0	2.5	100	66
	(2.9)	(3.9)	(3.4)	(6.7)	(5.6)		
444	2.0	2.3	2.1	2.5	2.3	19	9
	(4.5)	(5.0)	(4.7)	(5.5)	(5.1)		
2	2.0	3.4	2.7	3.8	9.2	41	230
	(4.4)	(7.4)	(5.9)	(8.3)	(20.1)		
666	1.9	3.8	2.9	5.0	18.0	72	520
	(4.3)	(8.4)	(6.3)	(11.1)	(39.7)		
888	2.3	4.5	3.2	3.6	8.2	12	156
	(5.0)	(10.3)	(7.1)	(8.0)	(18.0)		
3	1.7	5.3	3.5	4.5	7.1	28	105
	(3.8)	(11.7)	(7.7)	(9.8)	(15.7)		
333	1.6	5.6	3.6	3.5	4.6	−3	28
	(3.5)	(12.4)	(7.9)	(7.6)	(10.1)		
222	2.6	4.9	3.7	4.2	4.3	13	16
	(5.7)	(10.7)	(8.2)	(9.2)	(9.4)		
33	2.1	5.8	3.9	3.5	3.8	−10	−7
	(4.6)	(12.8)	(8.7)	(7.6)	(8.3)		
6	2.5	5.5	4.0	2.7	4.9	−32	22
	(5.6)	(12.0)	(8.8)	(5.9)	(10.8)		
555	2.8	5.6	4.2	3.3	2.6	−21	−38
	(6.1)	(12.3)	(9.2)	(7.3)	(5.7)		
11	2.1	6.3	4.2	3.6	4.5	−14	8
	(4.7)	(13.9)	(9.3)	(7.9)	(9.8)		
66	3.0	5.8	4.4	3.5	5.2	−20	18
	(6.6)	(12.7)	(9.6)	(7.7)	(11.4)		
44	3.4	5.8	4.6	9.4	8.2	105	78
	(7.6)	(12.7)	(10.1)	(20.3)	(18.0)		
5	4.4	5.2	4.9	9.4	8.9	92	81
	(10.0)	(11.5)	(10.7)	(20.3)	(19.6)		
77	3.3	7.7	5.5	3.3	6.9	−40	25
	(7.3)	(17.0)	(12.1)	(7.2)	(15.1)		
111	3.7	7.4	5.5	4.4	7.8	−20	42
	(8.2)	(16.2)	(12.2)	(9.6)	(17.1)		
999	3.0	8.7	5.9	4.0	18.6	−32	46
	(6.7)	(19.2)	(12.9)	(8.8)	(41.0)		
22	4.5	10.6	7.1	5.6	9.4	−21	32
	(9.9)	(21.3)	(15.6)	(12.3)	(20.3)		
777	4.0	11.6	48.6	8.0	21.4	−18	149
	(8.8)	(25.8)	(17.3)	(17.7)	(47.0)		
55	9.9	13.8	21.8	17.5	19.2	47	63
	(21.8)	(30.2)	(6.0)	(38.5)	(42.3)		

[a] Values preceded by the minus (−) sign were decreases.

TENSILE STRENGTH AND STRETCH.

The tensile strength was measured in both directions by determining the load which was necessary to tear asunder test strips, out accurately with the threads, 5 cm. ($1\frac{3}{32}$ inches) wide by 30 cm. ($11\frac{13}{16}$ inches) long. All the specimens were tested at the same room humidity and temperature, and the rate of separation of the grips of the machine was about 15 cm. (6 inches) per minute.

The "stretch under load" is the amount which the specimen stretches before it tears. The "permanent stretch" is the amount of the permanent increase in length after the specimen has been torn. The stretch is expressed in terms of the percentage of the original length. The results given in Table 4 are the mean values obtained from three specimens of each sample taken in the warp and weft directions, and

Table 5 gives the averages of warp and weft. Table 4 is arranged in the order of decreasing values of tensile strength for the warp, and Table 5 in the order of decreasing average value.

TABLE No. 4.—*Tensile strength and stretch of warp and weft.*

Sample marked—	Tensile strength, kilogram per centimeter (pounds per inch).		Stretch.			
			Permanent, percentage.		Under load, percentage.	
	Warp.	Weft.	Warp.	Weft.	Warp.	Weft.
11	28.4 (159.0)	10.9 (61.0)	1.6	15.3	7.5	23.3
555	23.8 (133.0)	5.3 (29.8)	2.1	4.7	6.3	10.7
6	23.3 (130.4)	9.5 (53.0)	1.9	3.0	5.6	15.8
3	23.0 (129.0)	8.8 (49.3)	1.0	11.2	4.7	16.4
5	22.6 (126.8)	9.5 (53.0)	1.3	10.0	4.6	16.9
888	21.4 (120.0)	6.5 (36.4)	1.4	15.3	5.1	22.6
666	21.1 (118.2)	9.1 (51.0)	1.3	8.3	5.6	15.8
777	20.2 (113.0)	9.0 (50.5)	1.6	8.7	5.2	15.2
999	18.3 (102.5)	5.4 (29.2)	1.3	15.7	4.8	22.2
22	17.4 (97.5)	(12.2 68.5)	2.3	10.3	6.1	17.0
66	16.6 (93.0)	9.0 (50.5)	.9	13.7	4.5	22.0
44	14.5 (81.0)	4.5 (25.1)	.6	19.7	4.4	25.2
444	14.2 (79.5)	6.7 (37.5)	1.3	13.3	6.9	21.1
77	14.0 (78.5)	6.2 (34.7)	.4	10.0	3.7	21.3
222	13.9 (77.8)	8.9 (50.0)	.6	10.0	4.9	19.6
1	13.3 (74.5)	2.7 (15.1)	.8	10.3	3.9	17.2
111	13.2 (74.0)	6.6 (37.0)	.7	9.3	4.4	16.4
55	12.8 (71.7)	4.9 (27.4)	.6	16.6	4.2	22.5
2	12.5 (70.0)	3.6 (21.0)	1.0	15.0	4.3	22.4
333	11.4 (63.8)	5.8 (32.5)	2.2	10.0	6.4	17.0
4	11.0 (61.5)	9.1 (51.0)	.7	16.3	5.5	23.3
33	9.7 (54.4)	6.6 (37.0)	.6	9.6	4.0	14.3

TABLE No. 5.—*Average tensile strength and stretch.*

Sample marked—	Tensile strength, kilogram per centimeter (pounds per inch).	Stretch.	
		Permanent.	Under load.
		Per cent.	*Per cent.*
11	19.6 (110.0)	8.4	15.4
6	16.4 (92.0)	2.4	10.7
5	16.0 (89.5)	5.6	10.7
3	15.9 (89.0)	6.1	10.5
666	15.1 (84.5)	4.8	10.7
22	14.8 (83.0)	6.3	11.5
777	14.6 (81.5)	5.1	10.2
555	14.5 (81.2)	3.4	8.5
888	13.9 (78.0)	8.3	13.8
66	12.8 (71.7)	7.3	13.2
999	11.8 (66.0)	8.5	13.5
222	11.4 (64.0)	5.3	12.2
444	10.5 (58.5)	7.3	14.0
77	10.1 (56.5)	5.2	17.5
4	10.0 (56.0)	8.5	14.4
111	9.9 (55.5)	5.0	10.4
44	9.5 (53.0)	10.1	14.8
55	8.8 (50.0)	8.6	13.3
333	8.6 (48.0)	6.1	11.7
33	8.1 (45.3)	5.1	9.1
2	8.0 (44.8)	8.0	12.3
1	8.0 (44.8)	5.5	10.5

FOLDING ENDURANCE.

The folding tests consist in the determination of the number of alternate complete folds which a specimen will endure before it breaks under a given constant tension. The determinations were made on a Schopper folding machine, the constant tension being 1,000 grams (35 ounces avoirdupois), and the test strips 15 mm. ($\frac{1}{32}$ inch) wide by 95 mm. ($3\frac{3}{4}$ inches) long. The average rate of folding was 220 double folds per minute, and care was exercised to keep this uniform.

The numbers given in Table No. 6 represent the number of double folds, i. e., at each count the specimen was folded flat upon itself, then opened and folded at the same point flat upon itself in the reverse direction. The results are in each case the mean of at least three specimens of the sample, and are arranged in the order of decreasing values of average. These tests were all made at room humidity.

TABLE No. 6.—*Folding endurance.*

Sample marked—	Number of double folds.		
	Warp.	Weft.	Average.
555	115,653	142,466	129,059
333	118,792	26,046	72,419
222	94,180	35,240	64,710
777	68,948	27,410	48,179
666	69,703	13,607	41,655
111	33,867	36,325	35,096
999	43,245	25,635	34,440
55	49,710	1,000	30,355
4	12,922	40,277	26,599
33	32,840	20,275	26,557
1	38,729	10,273	24,501
444	37,919	10,621	24,270
44	34,993	12,185	23,589
11	23,373	23,600	23,486
3	16,307	21,553	18,930
2	22,410	9,650	16,030
66	18,779	11,825	15,302
77	16,925	6,766	11,845
888	11,453	5,766	8,609
22	8,807	4,352	6,579
6	9,436	1,860	5,648
5	7,722	1,197	4,459

WEARING ENDURANCE.

The wearing endurance was determined by an apparatus designed for the purpose. Strips of the sample, 5 cm. (2 inches) wide, were cut parallel with the warp. These strips were held with a uniform tension of 2 kg. (4.4 pounds) against a ribbed cylindrical surface having a reciprocating motion. The wearing was measured by the number of reciprocations of the standard surface which would wear the cloth until the strip broke under the tension. The values are shown in Table No. 7.

TABLE No. 7.—*Wearing endurance.*

Sample marked.	Reciprocations.	Sample marked.	Reciprocations.
555	419,900	6	142,914
333	280,526	11	142,378
777	268,940	3	138,825
666	262,316	5	129,931
2	260,429	222	86,533
1	258,093	33	72,833
888	240,790	66	53,620
22	221,448	4	52,535
999	220,610	111	49,289
444	211,720	77	40,016
44	176,759	55	26,455

INTERPRETATION OF RESULTS.

To form, from the values of the physical properties obtained in the tests, an accurate judgment of the relative suitability of the samples for the purpose for which they are intended it is necessary to arrange the samples in order of best values.

All of the properties determined do not have the same degree of importance and they have therefore been divided into two classes in which each would have equal values.

The most important or primary properties would be the "tensile strength," the "stretch under load," i. e., the material's capacity to yield under stress, the "folding endurance," "rubbing endurance," and "expansion" with absorption of moisture.

Properties of less importance, but still worthy of consideration and of about equal weight, would be the "permanent stretch" or "distortion under stress," the capacity for "absorption of moisture," the "friction," "weight," and "thickness."

PRIMARY QUALITIES.

In Table No. 8 the samples have been arranged in the order of best values of the primary qualities. The columns are arranged under each property so that the best mean values appear at the top and the sample's position in a column indicates its relation to the others.

As a sample's position in the various qualities changes, different ratings, from 20 in the first position to 1 in the last three positions, show the ratings which each sample should have in the primary qualities.

TABLE No. 8.—*Primary qualities.*

Position rating	Tensile strength.	Stretch under load.	Folding endurance.	Wearing endurance.	Expansion with moisture.
20	11	77	555	555	444
19	6	11	333	333	777
18	5	44	222	777	999
17	3	4	777	666	44
16	666	444	666	2	55
15	22	888	111	1	6
14	777	999	999	888	22
13	555	55	55	22	555
12	888	2	4	999	66
11	66	66	33	444	2
10	999	222	1	44	33
9	222	333	444	6	11
8	444	22	44	11	3
7	77	6	11	3	111
6	4	5	3	5	222
5	111	666	2	222	1
4	44	3	66	33	77
3	55	1	77	66	4
2	333	111	888	4	5
1	33	777	22	111	666
1	2	33	6	77	888
1	1	555	5	55	333

SECONDARY QUALITIES.

Table No. 9 shows rating of the samples in the secondary qualities arranged by the same methods employed with the primary qualities.

TABLE No. 9.—*Secondary qualities.*

Position rating.	Permanent stretch.	Absorption of moisture.	Friction (normal humidity).	Weight.	Thickness.
20	44	2	1	2	2
19	55	666	4	1	1
18	4	6	444	333	444
17	999	55	2	444	44
16	11	22	666	44	888
15	888	111	888	888	999
14	2	5	3	3	4
13	66	999	333	4	55
12	444	77	222	55	66
11	22	11	33	555	333
10	3	222	6	77	77
9	333	777	555	222	3
8	5	44	11	66	666
7	1	33	66	999	555
6	222	888	44	777	777
5	77	66	5	666	6
4	33	333	77	22	33
3	777	444	111	33	5
2	111	4	999	5	22
1	666	1	22	111	111
1	555	555	777	6	222
1	6	3	55	11	11

CLASSIFICATION.

In Tables 8 and 9 the marks of the samples have been arranged in the order of the best values for each property.

There are five properties grouped in each table. If any one sample had excelled in all properties, it would have appeared at the top in each column, and its grade would have been the sum of the position ratings—i. e., 20+20+20+20+20=100. Some samples excel in one property, others in other properties. Therefore if we take the sum of the position ratings of a sample as they appear in Tables 8 and 9, we will form a fair estimate of the relation which that sample bears to *all* of the others in *all* the properties tabulated.

For example, in Table 8 "primary properties," the sample marked 66 stands 11 in "tensile strength," 11 in "stretch under load," 4 in "folding endurance," 3 in "wearing endurance," and 12 in "expansion and moisture." Its rating would therefore be 11+11+4+3+12=41—i. e., 41 per cent on a basis of 100 points for perfection in all qualities.

In Table 10 these ratings have been collected for both the "primary" and "secondary properties," and it is necessary to devise a means of final comparison and classification.

If we assume that the "primary properties" are twice as valuable and necessary in judging the quality of the sample, we should give its rating twice the weight in taking the mean of the ratings in the two different classes of properties.

This would be a weighted mean, and the arrangement in Table 10 is in the order of the "weighted mean."

The division into classes is entirely arbitrary, and is made according to the percentages in the weighted mean.

TABLE No. 10.—*Classification by physical properties.*

Class.	Sample marked—	Primary qualities.	Secondary qualities.	Weighted mean.
		Per cent.	*Per cent.*	*Per cent.*
First	444	64	68	65
	777	69 (85)	25	65
	555	67 (82)	29	64
	999	68	54	63
	44	57	67	60
	2	45	91	60
	55	46	62 (76)	56
Second	11	63	37	54
	666	55	49	53
	22	51 (62)	34	53
	4	40	66 (80)	53
	333	50	55	52
	888	44	67	52
	1	34	66 (81)	49
Third	6	51	35	46
	222	48	38	45
	66	41	45	42
	3	42 (31)	48	37
Fourth	5	33	32	33
	111	30	22	27
	33	27	29	27
	77	35 (20)	41	27

NOTE.—Where two different values are given the value in parentheses ( ) is a "weighted value determined by the consideration of the variation of individual percentages.

CONCLUSION.

In considering the samples from the standpoint of the physical properties, those standing in the first class are the best, and the first four are, for practical purposes, equal.

The second class are good fabrics and might be used to advantage where the volume would not be subjected to the most severe treatment and if there was considerable saving in expense.

The third and fourth class samples could not be recommended for bindings requiring great permanency and subjected to considerable usage.

In considering the samples from the physical and chemical properties they would be arranged according to Table 11. In this table the assumption is made that the same coloring matter is used in the delivery as was used in the sample and the cloth would be subjected to the changes by light as recorded.

TABLE No. 11.—*Final classification by physical and chemical properties.*[a]

Sample marked—	Physical properties, weighted mean.	Chemical properties.	
		Change by light.	Attacked by bugs.
	Per cent.		
777	65	None	None.
999	63	.....do	Do.
2	60	Slight (lighter)	Medium.
666	53	Doubtful	Practically none.
888	52	None	Slight.
22	53	Medium (darker)	None.
555	64	Very (strong)	Medium.
44	60	Decided (lighter)	Slight.
444	65	None	Nearly stripped.
55	56	Strong (lighter)	None.
4	53	Decided (darker)	Slight.
333	52	None	Strong.
66	42	.....do	Medium.
1	49	.....do	Nearly stripped.
6	46	Decided (darker)	Slight.
222	45	.....do	Do.
11	54	Very strong (lighter)	Very strong.
5	33	Medium (darker)	Slight.
3	37	Strong (darker)	Do.
33	27	Very strong (lighter)	Medium.
111	27	Strong (darker)	Nearly stripped.
77	27	Very strong (lighter)	Very strong.

[a] This classification is made on the assumption that the coloring matter used in the sample would be used in the delivery.

In Table 12 a rearrangement has been made upon the assumption that the manufacturer might find it practicable to modify the color by omitting the color constituent which is acted on by the light. The change of color by light would then fall out of consideration and the samples should be judged according to their arrangement in Table 12.

TABLE No. 12.—*Final classification by physical and chemical properties.*[a]

Class.	Sample marked—	Physical properties, weighted mean.	Chemical properties.	
			Change by light.	Attacked by bugs.
		Per cent.		
	777	65	None	None.
	999	63	.....do	Do.
	2	60	Slight (lighter)	Medium.
	666	53	Doubtful	Practically none.
	44	60	Decided (lighter)	Slight.
	55	56	Strong (lighter)	None.
	22	53	Medium (darker)	Do.
	555	64	Very strong	Medium.
	444	65	None	Nearly stripped.
	4	53	Decided (darker)	Slight.
	888	52	None	Do.
	333	52	.....do	Strong.
	11	54	Very strong (lighter)	Very strong.
	66	42	None	Medium.
	6	46	Decided (darker)	Slight.
	222	45	.....do	Do.
	1	49	None	Nearly stripped.
	5	33	Medium (darker)	Slight.
	3	37	Strong (darker)	Do.
	33	27	Very strong (lighter)	Medium.
	77	27	.....do	Very strong.
	111	27	Strong (darker)	Nearly stripped.

[a] This classification is made on the assumption that the coloring matter could be changed to one that would be more permanent.

LETTER FROM THE LIBRARIAN OF CONGRESS TRANSMITTING MEMORANDA IN RELATION TO REPORTS OF THE UNITED STATES BUREAU OF STANDARDS.

LIBRARY OF CONGRESS,
OFFICE OF THE LIBRARIAN,
Washington, May 18, 1908.

SIR: In response to your communication of April 22, 1908, in which you request an expression of opinion as to the relative importance of certain chemical and physical tests applied to book cloths as described in the report from the Director of the United States Bureau of Standards, I submit herewith three memoranda—from the Chief of the Division of Documents (Mr. J. D. Thompson), the Superintendent of Reading Room (Mr. W. W. Bishop), and the Assistant in Charge of the Binding Division (Mr. A. R. Kimball), respectively. These reports were drawn up independently, and it is hoped that the information and suggestions therein will prove of service to the committee.

I note from your communication that the book cloths under consideration are intended chiefly for use in the binding of Government publications intended for the depository libraries. The Library of Congress is much interested in the proposal to change the binding of Government publications. The sheep binding heretofore used has proved very unsatisfactory, and a change in binding is much to be desired.

It is believed that of the cloths submitted those indicated by the Chief of the Division of Documents and the Superintendent of the Reading Room would prove much superior to sheep in the binding of public documents.

Very respectfully,

HERBERT PUTNAM,
Librarian of Congress.

Mr. VICTOR L. RICKETTS,
Secretary Printing Investigation Commission,
Washington, D. C.

MEMORANDUM FROM THE DIVISION OF DOCUMENTS MAY 6, 1908.

[Referring to report of the Bureau of Standards on book cloths.]

To the LIBRARIAN OF CONGRESS.

SIR: I beg to submit the following suggestions in regard to the results on the tests furnished in the report of the Bureau of Standards to the Printing Investigation Commission:

Attack by insects.—As the depository sets of United States documents are housed in all sorts of library buildings and are intended as

a permanent reference collection for the people in the Congressional district where they are located, it is desirable that no binding material should be used which is readily attacked by insects. The results of this test should be used to eliminate all such as are badly eaten. On this account the following should be rejected at once and not given further consideration: Nos. 111, 222, 444, 1, 77.

Action of light.—The results of these tests should be used to eliminate certain coloring matters rather than particular cloth, because it appears that different dyes may be used with the same material. The tests show that the dark-green coloring of No. 555 is specially undesirable and should not on any account be used. Next to this, considerable fading is shown in No. 11, probably due to organic coloring matter, and if this cloth is used for any purpose provision should be made for the omission of the particular dye which causes the color to fade.

Absorption of moisture.—The increase of weight due to the absorption of moisture is not in itself a factor of much importance, unless it can be shown that it bears a direct relation to the liability to mold, and no such data have been furnished. The change in dimensions with humidity is, however, of considerable importance, because of the distortion of the binding which might result. The cloths should, therefore, be graded on this part of Table 2 only. An examination of the results shows that No. 333 has an excessive variation in dimensions with moisture, amounting to as much as 3½ per cent for the weft at a 100 per cent humidity. This would, in my opinion, render it quite impossible as a binding for the quarto volumes in the Congressional document set, because the shrinkage of a 30^{cm} cover from the 100 per cent humidity to bone dry would, in the direction of the weft, amount to a whole centimeter, and in the direction of the warp almost as much. This sample should, therefore, be rejected on this account. This test shows that Nos. 666, 5, 888, and 4 are not very satisfactory, but not sufficiently unsatisfactory to cause rejection on this account.

Friction.—Examination of the results under this head (Table No. 3) shows that No. 55 has an excessive value for the friction between two surfaces of the material, and this means that it would take a considerable force to pull out the book from a full shelf, which would produce a severe strain at the top of the back, and since No. 55, as shown by Table No. 40, stands low in tensile strength the back would soon be torn off. Sample No. 55 should, therefore, be rejected because of the combination of high friction and low tensile strength. The friction at normal humidity is the only test whose results should be taken into account, because nothing definite can be inferred from the remaining columns in Table 3.

Tensile strength and stretch.—Tensile strength is a factor of the greatest importance, but it is difficult to attach any definite significance to "permanent stretch" or "stretch under load," as far as the use of binding material is concerned. I have accordingly neglected the results of stretch in grading the material under this head in the final table.

Folding endurance.—Also a very important test. The very high value for No. 555 represents an endurance far beyond the needs of any possible use, so that, for practical purposes, the relative difference between Nos. 555 and 777 could not be represented by any greater difference in marks assigned than 20 and 19, respectively.

Wearing endurance.—Almost all of the samples, except those rejected for other reasons, show sufficient wearing endurance for practical purposes, Nos. 66 and 4 being the weakest in this respect.

Combination of results.—In the accompanying table I have assigned marks to the different samples representing the value of the results for bookbinding purposes proportionally rather than in mere numerical order, giving to the best values the mark of 20 for the test of "tensile strength," "folding endurance," "wearing endurance," and a mark of 10 to the best under the headings "attack by insects," "absorption of moisture" (change of dimensions), and "friction." In the table the sample marks are given in the order of the final classification of the Bureau of Standards Table No. 12.

Sample marked—	Attack by insects.	Absorption of moisture.	Friction.	Tensile strength.	Folding endurance.	Wearing endurance.	Total marks.
777	10	10	5	15	19	18	77
999	10	10	7	12	17	18	74
2	6	8	9	8	14	18	63
666	10	5	9	15	19	18	76
44	8	9	8	10	16	17	68
55	Rejected—excessive friction, combined with low tensile strength and wearing endurance.						
22	10	8	6	15	9	18	66
555	6	10	8	15	20	20	79
444	Rejected—strongly attacked by insects.						
4	8	5	10	10	16	12	61
888	8	5	9	14	11	18	65
333	Rejected—excessive change of dimensions with moisture; also strongly attacked by insects.						
11	4	7	8	20	16	16	71
66	6	7	8	13	14	12	60
6	8	9	8	17	8	16	64
222	Rejected—strongly attacked by insects.						
1	Rejected—strongly attacked by insects.						
5	8	5	8	16	7	16	60
3	8	7	9	16	15	16	71
33	6	8	8	8	16	14	60
77	Rejected—strongly attacked by insects.						
111	Rejected—strongly attacked by insects.						

The order of merit as shown by the marks in this table is as follows:

Sample marked.	Total marks.	Sample marked.	Total marks.	Sample marked.	Total marks.
55	79	44	68	4	61
777	77	22	66	66	60
666	76	888	65	5	
999	74	6	64	33	
11	71	2	63		
3					

It appears to me that the best four cloths, therefore, are Nos. 555, 777, 666, and 999. Of these, the first named (555) is an impossible color, and it is as yet uncertain whether the substitution of a different dye would not introduce other disadvantages, such as rendering it attractive to insects or reducing its strength in some way. I therefore incline to the use of one of the other cloths (777, 666, 999), which have the further advantage that they resemble sheep in color, and consequently, by using the same colored leather labels as at present, the general appearance of the Congressional set could be maintained. The rest of the cloths, except those rejected, may be regarded as

second-class materials for this purpose. They are also, with the exception of Nos. 888 and 2, unsatisfactory colors.

No test has been made as to the soiling of the materials submitted, nor would it be easy to devise such a test. I do not think, however, that any one of the three samples (777, 666, 999) would show the effects of soiling abnormally. Sample volumes might be bound and handled in order to determine whether this is so or not.

Very respectfully,

(Signed) J. DAVID THOMPSON,
Chief, Division of Documents.

MEMORANDUM FROM THE SUPERINTENDENT OF THE READING-ROOM DIVISION, MAY 8, 1908.

[In the matter of the report on samples of book cloths made by the Bureau of Standards.]

To the CHIEF CLERK.

SIR: The report is most valuable, and in the main coincides with my previous impressions, based on experience of many years in preparing books for binding and observing the results of the binder's work as tested by actual use.

There are certain matters which may well be considered as a preliminary in my discussion of this report. Librarians are generally agreed (and my own experience and observation leads me to concur heartily in the common verdict) that there are four requisites which must be met by any cloth used in binding. They are—

(1) The color must be fast, or reasonably so, and dark enough not to show the dirt, which much handling necessarily leaves on the surface.

(2) The cloth must be of enough tensile strength to prevent the sagging caused by the weight of the paper. In other words, the cloth must be strong enough to hold firmly in position without sagging a volume of some weight.

(3) The cloth must withstand a severe strain at the joint caused by frequent opening and shutting.

(4) The cloth must be reasonably smooth, so that the volume may be placed between others and again removed without undue friction.

These considerations are absolutely essential to securing a good cloth binding. It is generally considered unwise to bind very large volumes in cloth, because when so bound the paper pulls the binding out of shape, and the binding is likely to crack and tear at the joint in a very short time.

Granted the above considerations, and taking into account the experience of librarians with regard to cloth-bound volumes, it may be said that the most important tests are those for tensile strength; the number of threads per 2 centimeters, and for the exposure to sunlight, and for friction.

It will be noted that the two samples which best meet the test of exposure to light and for immunity from the action of water bugs are both very closely woven and of high tensile strength.

The question of attack by insects I should not regard as a serious one in this connection. When water bugs or other destructive insects are found in library buildings in this country they usually fail to

damage the books to any great extent, and their presence is generally accounted for by carelessness in the complete disposal of fragments of food eaten in the building. Ordinary precautions of cleanliness, such as usually obtain, are sufficient to protect books from damage by insects in our climate.

Damage to books and papers by light, or by the products of combustion of illuminating gas, or by the other gases in the atmosphere is a much more serious problem than damage caused by insects. No cloth (or, for that matter, leather) should be adopted for binding which changes color to any marked degree on exposure to sunlight or which is seriously disintegrated by the presence of gas in the atmosphere of cities.

With regard to the other tests made, I am inclined to think, as a result of my observations, that the matters of absorption of moisture and the expansion and contraction with changes of moisture are relatively unimportant. All binders object to the use of any kind of cloth, because there is a certain amount of this contraction and expansion from the use of paste in almost all binding cloths. They are forced to find out by experience the best methods of "working on" whatever cloths they adopt.

There is comparatively small weight to be attached to the matter of the absorption of moisture from the atmosphere. It occasionally happens, in the extremely damp buildings, that the humidity is great enough to induce the growth of mold upon cloth bindings. I have never seen a case of "serious distortion of bindings" arising from dampness. Of course I except the damage done by the actual contact of water, such as that due to exposure to rain.

The test for friction is very important, and is one which always receives consideration from librarians in selecting binding cloth. Any cloth which has a very rough surface, such as canvas or the coarser grades of buckram, suffers both from the accumulation of dust in the crevices of the weave and from long-continued friction in removing a book from the shelves and in replacing it. It is not too much to say that the friction test is almost as important as that for tensile strength, because of the added amount of pressure brought on the back of the book, when by reason of the character of the binding material additional strength is exerted in moving it in and out of its place on the shelf. When there is a shelf full of books bound in canvas, if they are placed at all tightly, it frequently happens that several books will be pulled down by the effort to remove one.

In considering a binding material for sets of Government documents, tensile strength becomes of even greater importance than when cloth is employed for binding only the thinner volumes, as is usually the case in libraries. In this connection it may not be out of place to suggest that a happy solution of the problem of binding heavy and large volumes in cloth has been reached by the bindery of the University of Michigan Library. Everyone is agreed that heavy books are with difficulty preserved in good condition when bound in cloth. It is also perfectly patent that the cloth binding is less expensive than leather and more sightly and durable than cheap leather. Mr. W. C. Hollands, who is in charge of the printing and binding at the University of Michigan, has for some time followed a practice which might be introduced with profit in the binding of Government documents. He secures, at a very small cost, the "inside splits" of

a very good quality of morocco leather. (These have all the tensile strength and pliability of the highly finished "outside splits," and cost about one-tenth the price of the finished leather.) He uses this leather to make a "tight back" binding for the books. This style of binding is universally held to be the strongest and most lasting known. He then proceeds to make an ordinary "spring back" covering of cloth. In this way he secures all the admitted strength of the tight-back leather binding (which is, of course, concealed from view), without the expense of the highly finished skins or of the binder's work in finishing leather, and at the same time the volumes so bound are neat in appearance, move easily on the shelf, retain their color for an indefinite period, and are labeled with printer's ink instead of gold.

There is a greater cost for labor in thus binding heavy volumes than would be the case were they bound in cloth alone, but by the use of this method it would be possible to employ a lighter and less expensive cloth of fast color with better results, in the case of volumes of more than 200 pages, than will be obtained by any purely cloth binding.

The folding test is of great importance, but it would seem that practically all the samples withstand this test to a remarkable degree. It might therefore be omitted in computing the final results.

The same thing is to a certain extent true of the wearing endurance test. The chief wear on all books is on the bottom, and no binding material fails to show abrasion at this point sooner or later.

I am inclined to agree with the general division into primary and secondary qualities, although it will be seen from what I have said above that I attach more weight to the quality of permanent stretch than I do to that of expansion with moisture, and more to that of friction than to expansion with moisture.

General conclusions.—The samples receiving the highest average—Nos. 777, 999—are both cloths which would undoubtedly appeal favorably to a librarian who should receive them as samples of cloth for binding, although they are both open to the objection that they would become soiled somewhat easily because of their light color. Any one or all of the first four would take printer's ink for lettering, and none of them would take either gold or silver gilt well. They are all of fine weave and a small amount of coating. The amount of coating is a matter which should always receive serious consideration.

If we were to ignore the tests of the Bureau of Standards and consider the samples only in the light of practical experience in judging book cloths, I have no hesitation in saying that the first four numbers—i. e., 777, 999, 2, and 666—would undoubtedly be among those picked out as the best of the lot, save that 2 is too light for heavy books.

While not in entire accord with the grouping of values made in these tests, the final outcome seems to me entirely satisfactory.

It seems to me doubtful whether these cloths would work well on heavy books, but even so they would be better than the present sheep binding. If some such practice as that followed at the University of Michigan should be adopted for the heavier volumes, I have no question that any of the four mentioned above would be extremely successful.

Very respectfully,

(Signed) WM. W. BISHOP,
Superintendent of the Reading Room.

MEMORANDUM FROM THE BINDING DIVISION, APRIL 27, 1908.

[Referring to Printing Investigation Commission tests.]

To the LIBRARIAN OF CONGRESS.

SIR: In response to the inquiry of the Printing Investigation Commission, I beg to submit the following opinion on the relative importance of the tests described:

Library bindings, as regards material, wear out chiefly at three points: (1) The joint, where the cover hinges upon the back; (2) the head, which usually receives some strain in taking a book from the shelves; (3) the tail edges, where the book strikes the shelf. Of these the joint is by far the most important and the tail edges least so, structurally considered. Accordingly I would place "Tensile strength" and "Folding endurance," combined, without allowing a high rating in the one to compensate for defects in the other, as the main consideration. In addition, doubtless a good working average should appear under the headings "Stretch under load," "Expansion with moisture," etc., but I can not see any good reason why a higher rating under these headings should compensate for deficiencies in the other important qualifications.

For example, take the two samples, No. 2 and No. 666. It occurred to me at once that the former is best suited for a frail pamphlet binding, while the latter might answer for the book of ordinary size, such as would rest on the shelves most of the time. Contrary to this view, in the final findings, Table No. 10, No. 2 is rated 7 points ahead of No. 666. But turning to Table 8, "Primary qualities," it appears that No. 2 stands in the lowest class under "Tensile strength" and only fifth from the lowest under "Folding endurance," while No. 666 is fifth from the head in both classes.

I am making two additional suggestions on the general scope of the tests:

(1) These investigations are so painstaking, complete, and interesting as regards the figures and data reported it seems regretable that they are limited to one general class; and also that a comparison of absolute and relative prices, in view of the shorter or longer life of the materials, is not produced in connection with the cost of labor which must go into all these bindings alike. It might be interesting to compare the linens, linen buckrams, law buckrams, and fine ducks with these cotton fabrics; also some of the moderate-priced leathers that have recently been placed on the market, produced according to the methods recommended by the committee of the Society of Arts. Among the latter may be mentioned pigskin. It is necessary to add that pigskin so produced is a very different article from that which is sometimes used by binders.

(2) I believe, in view of the samples, that difficulties would appear, in practice, in binding the books of larger size, those containing many maps, plates, etc., and that it would be necessary that some person or board be authorized to make distinctions in binding different sets as regards the covering material. Such supervision and discretion is necessary in all binding for libraries.

With regard to the water bugs and the colors of cloth reported on by the Chemical Division, we can say, in the first place, that we believe we have permanently cleared our bindery of water bugs by a

simple means. These bugs have never touched the bindings outside of the bindery itself.

It is said that a thin coating of shellac varnish is a sure protection after the book leaves the bindery, and this has been in long use in tropical countries.

As regards color, we have found, in a general way that the cloth should be of the same color all through. A strong color on the surface of a white cloth is never very enduring.

In conclusion I beg to state that no sheepskin has been used in the Library bindery for many years, and I sincerely believe that a better binding material than the thin-split sheepskin used on Government documents can easily be found.

Respectfully,

(Signed) A. R. KIMBALL,
Assistant, in Charge Binding Division.

ACTION OF THE JOINT COMMITTEE ON PRINTING.

In the first session of the Sixtieth Congress the Printing Investigation Commission recommended the enactment of the following joint resolution, which was passed, and was approved on January 15, 1908:

Joint Resolution amending an act relative to the public printing and binding, approved March first, nineteen hundred and seven.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That publications ordered printed by Congress, or either House thereof, shall be in four series, namely: One series of reports made by the committees of the Senate, to be known as Senate reports; one series of reports made by the committees of the House of Representatives, to be known as House reports; one series of documents other than reports of committees, the orders for printing which originate in the Senate, to be known as Senate documents, and one series of documents other than committee reports, the orders for printing which originate in the House of Representatives, to be known as House documents. The publications in each series shall be consecutively numbered, the numbers in each series continuing in unbroken sequence throughout the entire term of a Congress, but the foregoing provisions shall not apply to the documents printed for the use of the Senate in executive session: *Provided*, That of the "usual number," the copies which are intended for distribution to State and Territorial libraries and other designated depositories of all annual or serial publications originating in or prepared by an Executive Department, bureau, office, commission, or board shall not be numbered in the document or report series of either House of Congress, but shall be designated by title and bound as hereinafter provided, and the departmental edition, if any, shall be printed concurrently with the "usual number:" *And provided further*, That hearings of committees may be printed as Congressional documents only when specifically ordered by Congress or either House thereof.

SEC. 2. That in the binding of Congressional documents and reports for distribution by the superintendent of documents to State and Territorial libraries and other designated depositories, every publication of sufficient size on any one subject shall hereafter be bound separately and receive the title suggested by the subject of the volume, and the others shall be distributed in unbound form as soon as printed. The Public Printer shall supply the superintendent of documents sufficient copies of those publications distributed in unbound form, to be bound and distributed to the State and Territorial libraries and other designated depositories for their permanent files. The library edition, as well as all other bound sets of Congressional numbered documents and reports, shall be arranged in volumes and bound in the manner directed by the Joint Committee on Printing.

SEC. 3. That section two of an act to amend an act providing for the public printing and binding, and so forth, approved March first, nineteen hundred and seven, is hereby repealed.

Approved, January 15, 1908.

On May 25, 1908, the Joint Committee on Printing, in order to make effective the provisions of the above resolution as it relates to the binding of public documents, adopted the following resolution:

Whereas the various librarians in charge of State and Territorial libraries and designated depositories, who are the custodians of public documents of the United States placed on file in those institutions, have repeatedly declared to the Joint Committee on Printing, in official and individual capacities, that the binding of these documents in sheep has become a source of embarrassment by reason of the lack of durability of this material under modern processes of manufacture; and

Whereas similar expressions have repeatedly been voiced in the proceedings of the American Library Association, and through its committees on binding and on relations with the Federal and State governments; and

Whereas the Printing Investigation Commission has invited an expression on this subject from the librarians in charge of the principal libraries of the United States, which expression confirms the opinions referred to above, and, after careful inquiry, has submitted to the Joint Committee on Printing certain samples of bindings tested by the United States Bureau of Standards, with a full report on the results and further reports from the Librarian of Congress in relation thereto: Therefore be it

Resolved, That the secretary of the Printing Investigation Commission be, and he is hereby, directed to confer with the chairman of the committee on binding of the American Library Association, the chairman of the committee on relations with the Federal and State governments of the American Library Association, the Librarian of Congress or such representative as he may designate, the Director of the Bureau of Standards or such representative as he may designate, the Public Printer or such representative as he may designate, and the superintendent of documents, who, with the secretary of the Printing Investigation Commission, shall examine the three samples marked "666," "777," and "999," designated in the reports of the Bureau of Standards in connection with the aforesaid tests, and which, in accordance with that report and the report of the Librarian of Congress, show the best adaptability to the binding of the library set of public documents, and such sample from among those hereinbefore indicated as a majority of the persons designated above may select, shall be certified by the secretary of the Printing Investigation Commission to the chairman of the Joint Committee on Printing, who, in turn, shall direct the Public Printer, under the provisions of the Joint Resolution Numbered Three of the first session of the Sixtieth Congress, approved January 15, 1908, to adopt material in accordance with such sample as the material to be used in the binding of the documents and reports required by law for the State and Territorial libraries and designated depositories, beginning with the documents and reports of the Sixtieth Congress.

On Monday, June 1, 1908, in accordance with the direction of the foregoing resolution, a meeting was held at the rooms of the Committee on Printing of the House of Representatives, at which were present, under the authority of the resolution, the following:

Mr. A. L. Bailey, chairman of the committee on bookbinding of the American Library Association;

Mr. Bernard C. Steiner, chairman of the committee on relations with the Federal and State governments of the American Library Association;

Mr. W. W. Bishop, representing the Librarian of Congress;

Mr. S. W. Stratton, Director of the Bureau of Standards;

Mr. Henry T. Brian, Acting Public Printer;

Mr. William L. Post, superintendent of documents, and

Mr. Victor L. Ricketts, secretary of the Printing Investigation Commission.

In addition to the above there were present by invitation the following:

Mr. Allen R. Boyd, chief clerk of the Library of Congress;

Mr. J. David Thompson, of the Library of Congress;

Mr. Daniel E. Douty, assistant physicist of the Bureau of Standards;
Mr. George F. Bowerman, librarian of the Washington Public Library and former chairman of the committee on bookbinding of the American Library Association, and
Mr. Peter Frank, foreman of binding of the Government Printing Office.

After full discussion of the reports of the Bureau of Standards and the Librarian of Congress and examination of the samples of book cloths submitted, the sample marked "666" was unanimously selected on motion of Dr. A. L. Bailey, the chairman of the committee on bookbinding of the American Library Association.

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